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lips gives two principles as the basis of Werner's system:

1. "When two veins cross, and one of them cuts through the other, the one which is divided is the more ancient."

2. "In effect, among superimposed stratified rocks, the lowest was deposited first and is the oldest."

Lehman, it seems, worked out these principles in part before Werner, but he fell short of his countryman in the extent of their application and significance.

By the first of Werner's laws, we determine not only the relative time of occurrence of veins and dykes, but also that of faults, joints, brecciation and other minutiae in modern petrographical investigations with the microscope. In the same category of contact phenomena might also be placed unconformities, the importance and use of which have only within a few years been fully elaborated by the geologists of the Lake Superior district.

The second of Werner's generalizations is to stratigraphic geology what the first is to the study of igneous rocks and secondary structures. How these, to us seemingly obvious, laws are used in modern geological instruction and field investigation is seen by Professor Davis's paper on "Instruction in Geological Investigation" (in *Am. Nat.*, xxi., 1887, pp. 810-825). One essential advance is in recognizing what Hutton insisted on, the intrusive origin of the igneous rocks, and in interpreting unconformities, but our method of diagnosing a field of outcrops or the structure of a mine is that which Werner pursued with his classes a century ago.

#### HABITS OF THE PURPLE FINCH — *COR- PODACUS PURPUREUS*, GRAY.

BY M. W. VANDENBURG, FORT EDWARD, N. Y.

THE pleasant articles contributed to *Science* by Dr. Morris Gibbs, on "Birds and Bird Life," have reawakened observations often made by me on the habits of this spirited little songster. Some of these habits are, in so far as I know, unique; others are rarely found in other species, while still others are common to many species.

In its arrival from the south the purple finch often divides honors with the song sparrow, and pours forth from the top of some tall naked maple or elm such a voluble, rattling, exuberant song it seems as if he must needs sing or burst. This, too, while fields are white and winds blowing keen. In ten days or so, the females appear in twos, threes or fours. In the little flocks, if so few as six to ten can be called a flock, every one goes as he or she pleases, though they always keep in sight of each other, or in hearing of the sharp "chick" call-note.

Soon as the days grow mild, and snow leaves the fields, mating begins; and now comes the strange part of the story. The females sing as well as the males, and, what is more, the full round of the "set song." That is, the purple finch has a full, regular song of a certain number of notes (words), always repeated in the same order, and with very rare variations from this order. It is repeated very rapidly in a loud, high-pitched key, and ends very abruptly in the early spring song of the male, and always so in the song of the female. In the later spring song of the male, there follows the loud song, a very soft tremulo strain containing, it always seemed to me, a mimicry of the notes of

other birds, among which one may detect one or two words from the pee-wee. This *sotto voce* song finally dies out as if he had forgotten the last notes, and often ends with a little whistle.

The female never aspires to this part of the song. Her song is a signal for all the males to assemble, and then the rapid fighting begins. The female downs fiercely every male who dares approach her, but is very lenient towards her own sex. So vicious and vigorous are her attacks that the male usually gives her a wide berth and keeps his eye quite as much on the avenue of escape as on her comely figure. This is no mistake of mine. It is not the song of an immature male.

And this is why I know I am correct. For several years I had a pair of these birds in a cage, where they were reared from the time they left the nest. On the approach of spring, say about the last of February or first week in March, the birds became very restless. They both began to sing; they grew very quarrelsome and constantly indulged in the fiercest brawls. Wilson says: "They appear to be of a tyrannical and domineering disposition," and not an hour passed in the day that did not demonstrate the correctness of this observation.

From being perfectly peaceful and considerate of each other, they grew so quarrelsome, so persistently pugnacious, that they disturbed the whole household, and often the cage had to be covered over to lessen the bickering. In these first days of war the female was always victor, and she was wholly merciless. Later on her courage gradually failed, and by the end of a month or six weeks they ceased to fight, the male having won the day. He would "boss the household" for a week or two, with a pretty firm hand of authority, but not until many a well-fought field had been lost and won for days and days in succession.

They could never be persuaded to build a nest. The female would lay from three to four eggs in the cage bottom. For one or two seasons a second laying succeeded, but this was not usual.

In the wild state the male never approaches the nest. He alights on a tree six to ten rods away and rapidly sings his full, *loud* song once or twice. The female answers him with a low call-note, leaves the nest and he feeds her from his "crop" in the same manner as the yellow-bird feeds its young. This done, he takes a hurried leave, and she returns to the eggs.

When the young first hatch this process continues, and the mother feeds them from her own crop, after being supplied by the male. Later on the male seems to forget his family altogether, or to feed the mother rarely and at a greater distance from the nest.

In the end, the whole care of the family seems to devolve on the female, and the ungracious sire never recognizes in any way his legitimate offspring.

I do not know whether the female sings previous to the second nesting or not, but would think it probable that such was the case for a few days at least.

I have met with unmated females singing as late as May or the first of June. The mated female, who no longer tolerates such giddiness and waywardness in a sister, pursues the singer with all the vim and viciousness she can command.

The male, too, not infrequently comes in for a bluff rebuke, if he is not discreet in his attentions to the coy spinster.

Such have been my observations of the purple finch, extending over a period of thirty years. They are in the main correct, as it seems to me, for they have received confirmations during every year of that time.